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(54) **PASSIVE BISTATIC RADAR FOR VEHICLE SENSE AND AVOID**

(75) Inventors: **Anthony P. Goodson**, Seattle, WA (US); **Michael A. Loudiana**, Maple Valley, WA (US)

(73) Assignee: **The Boeing Company**, Chicago, IL (US)

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Primary Examiner — John B Sotomayor
(74) *Attorney, Agent, or Firm* — Ameh IP; Elahe Toosi; Lowell Campbell

(57)   **ABSTRACT**

A system and methods for onboard sense and avoidance of an object are disclosed. At least one transmitter and at least one transmitter location of the at least one transmitter are selected from a database of transmitters based on a vehicle location of a vehicle, and at least one total signal is received at the vehicle. The at least one total signal comprises a direct signal of at least one broadcast signal from the at least one transmitter, and a reflection signal comprising a reflection of the broadcast signal reflected off an object. An estimated object location of the object is estimated based on the at least one total signal, the at least one transmitter location, and the vehicle location.

20 Claims, 7 Drawing Sheets

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702 — SELECT AT LEAST ONE TRANSMITTER AND AT LEAST ONE TRANSMITTER LOCATION OF THE AT LEAST ONE TRANSMITTER FROM A DATABASE OF TRANSMITTERS BASED ON A VEHICLE LOCATION OF A VEHICLE

704 — RECEIVE AT LEAST ONE TOTAL SIGNAL AT THE VEHICLE, THE AT LEAST ONE TOTAL SIGNAL COMPRISING A DIRECT SIGNAL OF AT LEAST ONE BROADCAST SIGNAL FROM THE AT LEAST ONE TRANSMITTER, AND A REFLECTION SIGNAL COMPRISING A REFLECTION OF THE AT LEAST ONE BROADCAST SIGNAL REFLECTED OFF AN OBJECT

706 — ESTIMATE AN ESTIMATED AIRBORNE OBJECT LOCATION OF THE OBJECT BASED ON THE AT LEAST ONE TOTAL SIGNAL, THE AT LEAST ONE TRANSMITTER LOCATION, AND THE VEHICLE LOCATION

708 — RECEIVE AT LEAST ONE SECOND TOTAL SIGNAL AT THE VEHICLE, THE AT LEAST ONE SECOND TOTAL SIGNAL COMPRISING A SECOND DIRECT SIGNAL OF AT LEAST ONE SECOND BROADCAST SIGNAL RECEIVED FROM AT LEAST ONE SECOND TRANSMITTER COMPRISING A DIFFERENT FREQUENCY SOURCE THAN THE AT LEAST ONE TRANSMITTER, AND A SECOND REFLECTION SIGNAL COMPRISING A SECOND REFLECTION OF THE AT LEAST ONE SECOND BROADCAST SIGNAL REFLECTED OFF THE OBJECT

710 — REFINE THE ESTIMATED OBJECT LOCATION BASED ON THE AT LEAST ONE SECOND TOTAL SIGNAL, THE AT LEAST ONE TRANSMITTER LOCATION, AND THE VEHICLE LOCATION

712 — CALCULATE A COMMANDED AVOIDANCE MANEUVER FOR THE VEHICLE TO ASSURE OPTIMAL SEPARATION BETWEEN THE VEHICLE AND THE OBJECT

714 — DISPLAY INFORMATION

716 — COMMAND THE VEHICLE TO OPTIMALLY EXECUTE THE COMMANDED AVOIDANCE MANEUVER BY ONE OF AN OPERATOR COMMAND AND AN AUTONOMOUS AUTOMATIC COMMAND